CHAPTER 46
SWAMP HARDWOOD TYPE

TYPE DESCRIPTION

A. Stand Composition

The major components of this type include **black ash** (*Fraxinus nigra*), **American elm** (*Ulmus americana*), and **red maple** (*Acer rubrum*).

B. Soil Preference

Sites are typically wet and subject to fluctuations in water table. When evaluating site potential, the drainage system within the stand should be evaluated when site index measurements are made. Swamp hardwood species can tolerate semi-stagnant drainage conditions, but for best growth it is important that the water be moving so that the soil is aerated even if saturated.

In contained systems with little or no water movement, partial or complete removal of the overstory without advance regeneration often results in a lack of repro- duction and loss of site. A rise in the water table from decreased transpiration inhibits stump sprouting and seedling establishment.

C. Site Quality

Plants are excellent indicators of drainage and site productivity. The *Field guide to habitat classification system for the upper peninsula of Michigan and northeast Wisconsin* (Coffman et al., 1980) or the *Guide to forest habitat types of northern Wisconsin* (Kotar et al., 1988) should be used where applicable to identify the areas that will provide the best opportunities for management.

SILVICAL CHARACTERISTICS*

Only black ash is included here because it is becoming the most important species from a management standpoint, although it remains the least understood component of the swamp hardwood type. The emphasis is on black ash because Dutch elm disease has eliminated elm from future silvicultural considerations, and because red maple is not considered to be difficult to regenerate.

Species	Black ash
Flowers	Dioecious; late April to early May
Fruit ripens	August to September
Seed Dispersal	October to early spring
Good Seed Years	Intervals of 1 to 8 years. Of 19 northern forest tree species surveyed in northeast Wisconsin over a 25-year period, black ash had the greatest number of successive years (seven) of poor seed crops (Erdman et al., 1986).
Germination	Seeds exhibit dormancy arising from immature embryos, respiratory enzyme inhibitors in the endosperm, and impermeable seed coats. A period of warm and cold stratification is required to break dormancy with the result that germination is normally delayed until the second year. The optimum germination temperature for black ash has not been documented (Johnson, 1976).
Seed Viability	Relatively long-lived; capable of remaining viable for eight years or more under natural conditions (Johnson, 1976).
Seedling	Slower than seedlings of associated species such as American elm and red maple (Johnson,

Development	1976).
Vegetative Reproduction	Young black ash sprouts readily from the stump, particularly if the stump is less than 12 inches in diameter. Black ash will also produce root suckers from cut trees.
Principal Enemies	**Trunk rot** (Stereum murraii)
	Butt rot (Armillarea mellea)
	Oystershell scale (Lepidosaphes ulmi) -- affects new growth and older trees
	Leaf spot (Mycosphgereela effigurata)
	Anthracnose (Gloesporium aridum)
	Rust (Puccinia peridermiospora)
	Canker (Nectria galligena)
	Spongy white heartwood rot (Polyporus hispidus)
	Deer -- browse heavily on sprouts
	Beaver -- cut black ash when aspen is scarce
	Eriophid mite -- kills female flowers

* From Fowells (1965) unless otherwise indicated.

MANAGEMENT ALTERNATIVES

The management objective should be identified in relation to other land management objectives and be based on site potential. Possible alternatives include managing swamp hardwood stands to produce the maximum quantity and quality of pulpwood and sawtimber. Because of our inability to consistently regenerate the swamp hardwood type, the use of various cutting methods and silvicultural activities will be encouraged on a limited scale only. These activities should be coordinated with and monitored by a DNR Timber Management Specialist throughout the seedling establishment stage (5 to 10 years).

SILVICULTURAL SYSTEM

Even-age management employing intermediate thinning and shelterwood harvesting techniques with emphasis on site classification.

MANAGEMENT RECOMMENDATIONS

A. Evaluating Site Productivity

Site index, defined here as the average height of five dominant and co-dominant black ash trees in a stand at reference age 50 (SI_{50}), can be used to estimate the productivity of a given site for black ash.
To determine site index, first select the trees you would like to leave as crop trees. Suitable crop trees are above average stand diameter, straight, single-stemmed, and without forks, serious diseases or injuries. Five sample trees are then selected for measurement.

Fell each sample tree and measure the total tree height to the nearest foot. Then cut a disk in cross-section, 1 to 2 inches thick, from just above the ground line (one or two inches). Count the rings on the disk, and use the site index curves (Carmean, 1978) in Figure 46.1 to determine the site index for each tree at reference age fifty. Estimate an average site index for the stand using Figure 46.2.

Three site productivity classes are recognized in the key to management recommendations:

Poor quality sites (SI_{50} less than 45) should be managed to maintain wildlife habitat and water quality.

Medium quality sites (SI_{50} between 45 and 55) can be expected to produce some small sawlogs (10 to 12 inches DBH).

High quality sites (SI_{50} greater than 55) can be managed primarily for large sawlogs (equal to or greater than 18 inches DBH).

B. Key to Management Recommendations (from Erdmann et al., 1987)

1.	Stand site index is less than 45	Manage to maintain wildlife habitat and water quality.
1.	Stand site index is 45 to 55	**2**
1.	Stand site index is greater than 55	**5**
2.	Soil is wet organic or muck	**3**
2.	Soil is mineral with poor or impeded drainage	**4**
3.	Stand basal area is less than 100 sq. ft. per acre	Review when stand reaches 100 sq. ft. per acre or is operable.
3.	Stand basal area is more than 100 sq. ft. per acre	Make a partial cut (if operable) to recommended all-age stocking level using upper DBH of 12 inches (Table 46.1).
4.	Stand basal area is less than 100 sq. ft. per acre	Review when stand reaches 100 sq. ft. per acre.
4.	Stand basal area is more than 100 sq. ft. per acre	Thin (if operable) to recommended even-age stocking level (Figure 46.2). First cut is to 80 percent crown cover. Subsequent cuts to 90 percent crown cover. Thin again after crown closure and lower branch mortality on crop trees.
5.	Average DBH is more than 18 inches on all trees greater than 4.6 inches DBH	**6**
5.	Average DBH is less than 18 inches on all trees greater than 4.6 inches DBH	**7**

6.	Black ash regeneration is adequate (more than 5000 stems per acre)	Make a shelterwood cut leaving 50 percent crown cover. Make a removal cut when regeneration is 2 to 3 ft. tall (after 3 to 5 years).
6.	Black ash regeneration less than 5000 stems per acre	Make a shelterwood cut leaving 75 percent crown cover. Reduce overstory crown cover to 50 percent when stocking becomes adequate; then make final removal cut as above in **6**.
7.	Stand basal area is less than 100 sq. ft. per acre	Review when stand reaches 100 sq. ft. per acre or is operable.
7.	Stand basal area is more than 100 sq. ft. per acre	Thin (if operable) to recommended even-age stocking level (Figure 46.2). First cut to 80 percent crown cover; subsequent cuts to 90 percent crown cover.

C. Thinning Swamp Hardwood Stands

Intermediate thinnings should be restricted to stands that are less than 110 years old, contain at least 100 square feet of basal area per acre, and will have time to respond to the thinning before the next harvest cut.

1. Reduce the residual basal area to prescribed stocking levels (80 percent crown cover for the first entry) using the even-age stocking guide for black ash (Figure 46.2). The stocking guide is based on the average residual DBH of all trees, 4.6 inches DBH and larger, after thinning. The cut should be primarily from below but an attempt should be made to free crop trees from poor quality main canopy competition.

2. Black ash has a narrower crown than sugar maple, red maple, or yellow birch. In pole-size stands, crop trees should be freed five feet beyond their crown perimeters. In sawlog-size stands, crop tree crowns should be freed from poor quality main canopy competitors.

3. Remove all high risk and cull trees with little growth and grade improvement potential to reduce mortality and upgrade the stand.

4. Discriminate against other species growing on mineral soils with poor or impeded drainage.

5. Later thinnings should be delayed until crowns close and lower branches die on the crop trees. Thinnings should be made to the 90 percent crown cover stocking level to maintain growth response and bole quality development on the main canopy island. Cuts should be primarily from below.

6. Small black ash stands (less than 10 acres) on impeded drainage ways in upland areas should be managed in the same manner as the surrounding stand (either even-aged or all-aged) because in wet situations black ash has a decided advantage over associated species regardless of the management system employed. Chapter 40 (Northern Hardwood Type) is the appropriate guide for managing small, upland black ash stands.

D. Regeneration Techniques

Even-age silviculture should be used to regenerate swamp hardwoods due to their relative intolerance to shade. However, management practices for the swamp hardwoods cannot be generalized. When selecting a cutting method, consideration must be given to its effect on the water table.

Shelterwood System

On non-organic sites with well-defined drainage patterns, the shelterwood system should be used to regenerate stands of black ash.

1. Select stands 15 to 18 inches DBH or aged 110 to 130 years or older.

2. If advance black ash regeneration is present, mark from below to leave 50 percent crown cover of the best growing stock. Favor black ash regeneration by discriminating against other species in the overstory.

3. If advance black ash regeneration is absent, mark from below (preferably during a good seed year) to leave 75 percent crown cover. When black ash regeneration appears, open the overstory canopy to leave 50 percent crown cover.

4. Remove the shelterwood overstory when the ground is frozen (preferably with more than 12 inches of snow cover) after seedlings attain a height of two to three feet (after three to five years). A minimum of 5000 well-spaced seedlings and low sprouts should be left per acre.

REFERENCES

Bonner, F. T. 1974. "*Fraxinus* L. Ash" in Agric. Handbook No. 450, *Seeds of woody plants in the United States.* C. S. Schopmeyer, ed. USDA-Forest Service: Wash., D. C. p. 411-416.

Boughner, W. S. 1955. The lowland hardwood forest type in southern Michigan. USDA-Forest Service, Lake States For. Exp. Sta.: St. Paul, MN. 19 pp.

Brand, G. 1981. General Technical Report NC-69, Stimulating timber management in Lakes States forests. USDA-Forest Service, North Central For. Exp. Sta.: St. Paul, MN. 25 pp.

Carmean, W. H. 1978. Research Paper NC-160, Site index curves for northern hardwoods in northern Wisconsin and upper Michigan. USDA-Forest Service, North Central For. Exp. Sta.: St. Paul, MN. 16 pp.

Carmean, W. H., J. T. Hahn, and R. D. Jacobs. 1989. General Technical Report NC-128, Site index curves for forest tree species in the eastern United States. USDA-Forest Service, North Central For. Exp. Sta.: St. Paul, MN.

Coffman, M. S., E. Alyanak, J. Kotar, and J. E. Ferris. 1980. *Field guide to habitat classification system for upper peninsula of Michigan and northeast Wisconsin.* Michigan Technological Univ.: Houghton, MI. 144 pp.

Erdmann, G. G., T. R. Crow, R. M. Peterson, Jr., and C. D. Wilson. 1987. General Technical Report NC-115, Managing black ash in the Lake States. USDA-Forest Service, North Central For. Exp. Sta.: St. Paul, MN. 21 pp.

Fowells, H. A. 1965. Agric. Handbook No. 271, *Silvics of forest trees of the United States.* USDA-Forest Service: Wash., D. C. p. 182-184.

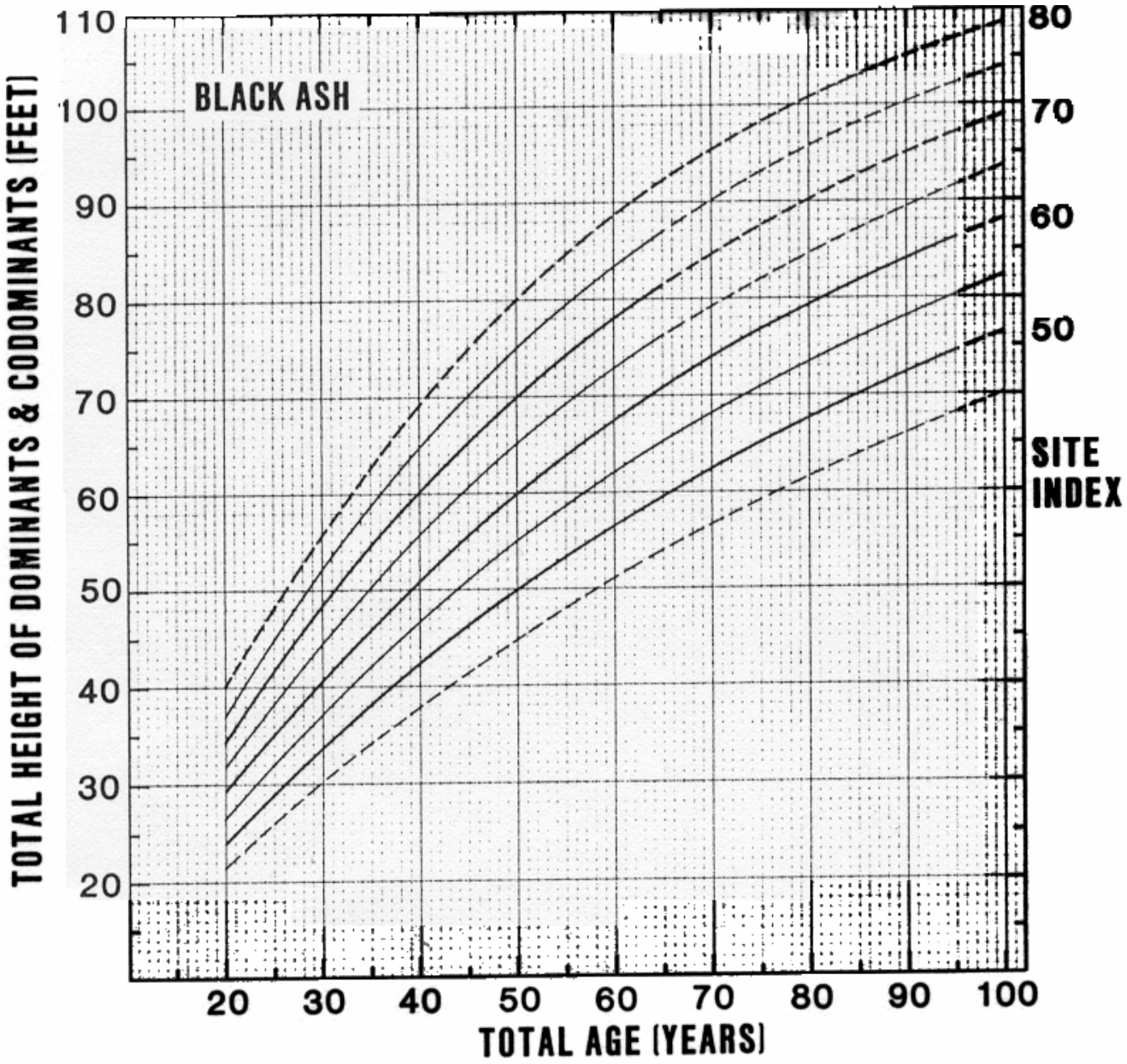
Godman, R. M., and G. A. Mattson. 1976. Research Paper NC 123, Seed crops and regeneration problems of 19 species in northeastern Wisconsin. USDA-Forest Service. 5 pp.

Johnson, P. S. 1976. Vegetational developments after logging in southern Michigan lowland hardwood forests. 17 pp.

Kotar, J., J. A. Kovach, and C. T. Locey. 1988. *Field guide to habitat types of northern Wisconsin.* Univ. Wisconsin-Madison and Wisconsin Department of Natural Resources. 217 pp.

USDA-Forest Service. 1977. Silvicultural practices handbook for the Chequamegon National Forest: Elm-ash Forest Type. p. 4030.

Figure 46.1 Site index curves for black ash in northern Wisconsin and upper Michigan (Carmean et al., 1989).



Black ash (Carmean 1978)
Northern Wisconsin and Upper Michigan
39 plots having 143 dominant and codominant trees
Stem analysis, nonlinear regression, polymorphic
Add 4 years to d.b.h. age to obtain total age (BH = 0.0)

	b_1	b_2	b_3	b_4	b_5	R^2	SE	Maximum difference
H	4.2286	0.7857	-0.0178	4.6219	-0.3591	0.99	0.70	2.4
SI	0.2388	1.1583	-0.0102	-1.8455	-0.1883	0.99	0.99	3.4

Figure 46.2 **Even-age stocking levels for black ash by crown cover, basal area, and trees per acre for specified average stand DBH classes (Erdman et al., 1987).**

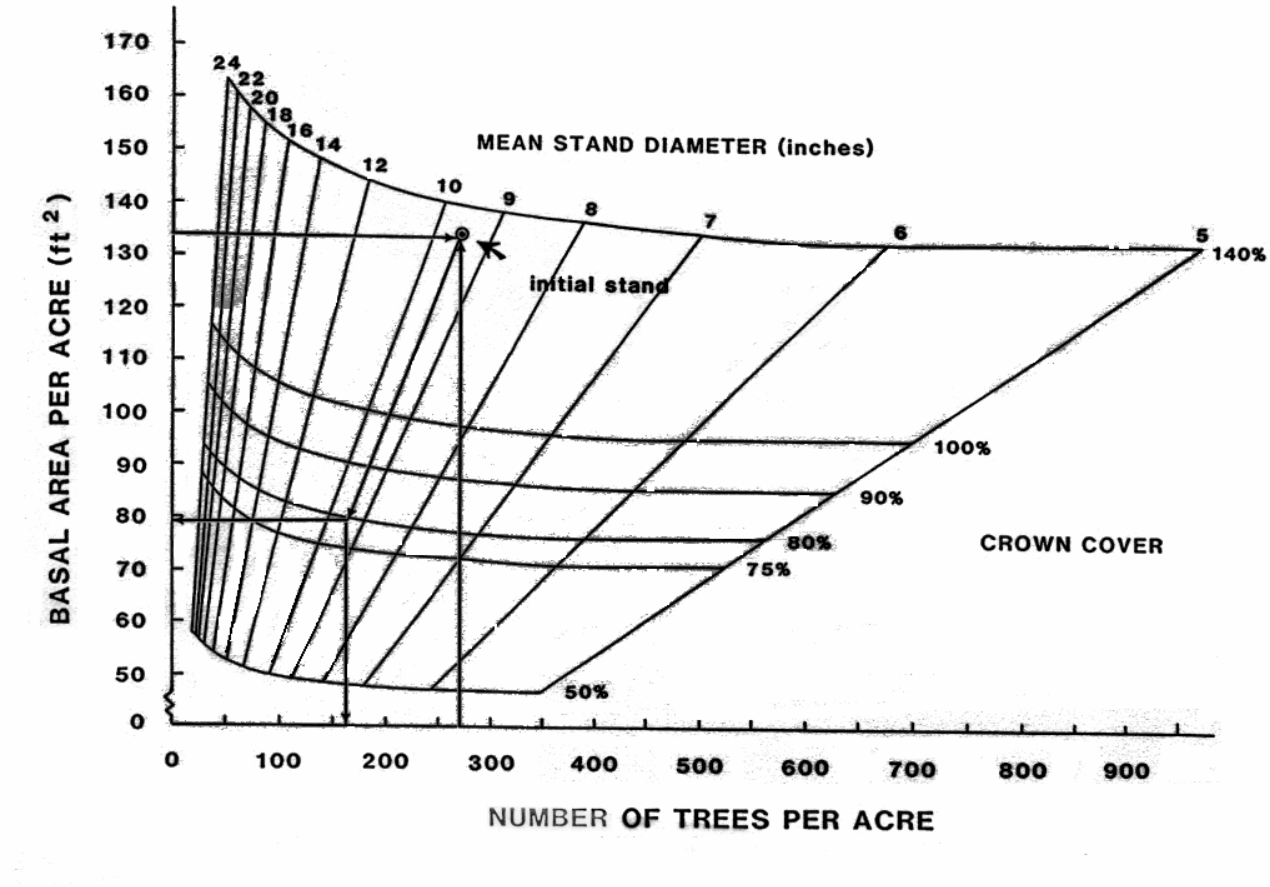


Table 46.1 Desired stocking after cutting for sustained growth of black ash on organic peat or muck soil (Erdmann et al., 1987).

	DBH class (inches)	Trees/acre (number)	Basal area/acre (square feet)
Poles	5	69	9.3
	6	53	10.3
	7	41	10.8
	8	31	10.9
	9	24	10.6
Subtotal		**218**	**51.9**
Small sawlogs	10	18	10.1
	11	14	9.4
	12	11	8.6
Subtotal		**43**	**28.1**
		—	—
Total		**261**	**80.0**

NOTE: Stocking recommendations are based on a maximum tree size of 12 inches DBH, a q factor of 1.3, and a basal area of 80 square feet per acre for trees 4.6 inches DBH and larger.